

CLAIMS

What is claimed is:

1. A process for treating waste water to remove contaminants from the waste water, wherein the process comprises:

10 A. treating recycled waste water with a coagulant and with non-dissolved air which is injected into the recycled waste water;

B. mixing the treated recycled waste water with untreated raw waste water;

15 C. adding a flocculating agent to the mixture of treated and untreated waste water to flocculate contaminants in the waste water mixture, whereby the air is entrapped within the flocculated contaminants;

D. moving the waste water mixture to a unit in which the flocculated contaminants rise to an upper area of the unit;

E. removing the flocculated contaminants from the upper area of the unit;

20 F. removing a first portion of the waste water mixture from a lower portion of the unit; and

G. recycling a second portion of the waste water mixture through the process.

25 2. A process as defined by Claim 1 wherein, prior to addition of the flocculating agent, the recycled waste water is treated with a pH adjusting material to adjust the pH of the recycled waste water.

5 3. A process as defined by Claim 2 wherein the pH adjusting material is a
tannin, lignin, hydroxide, metal-containing compound or acidic compound or a mixture
of such materials.

 4. A process as defined by Claim 3 wherein the pH adjusting material is a
10 tannin, lignin, ferric chloride, ferric sulfate, aluminum chloride, aluminum sulfate or a
mixture of such materials.

 5. A process as defined by Claim 3 wherein the pH adjusting material is
sulfuric acid, hydrochloric acid, nitric acid or a mixture of such materials.

15 6. A process as defined by Claim 3 wherein the pH adjusting material is
sodium hydroxide, potassium hydroxide, calcium hydroxide or a mixture of such
materials.

20 7. A process as defined by Claim 1 wherein the flocculating agent is a tannin,
lignin, cationic polymer, anionic polymer or a mixture of such agents.

 8. A process as defined by Claim 7 wherein the flocculating agent is a cationic
polymer, an anionic polymer or a mixture of such polymers.

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5 9. A process as defined by Claim 7 wherein the flocculating agent is a polyacrylamide.

 10. A process as defined by Claim 7 wherein the flocculating agent is a polyamine.

10 11. A process as defined by Claim 1 wherein the air is entrapped within the flocculated contaminants.

 12. A process as defined by Claim 1 wherein the second portion of the waste water mixture is recycled by a low pressure pump.

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 13. A process as defined by Claim 1 wherein the second portion of the waste water mixture is recycled by gravity flow.

 14. A process as defined by Claim 1 wherein molecules of the non-dissolved
20 air attach to the coagulant, and an initial pin floc is formed in which the air molecules are entrapped within the pin floc.

 15. A process as defined by Claim 1 wherein the air is not pressurized to a point at which air can be dissolved.

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5 16. A process as defined by Claim 1 wherein the waste water is recycled by a pump which does not operate at the pressure required to dissolve the air.

 17. A process for treating waste water to remove contaminants from the waste water, wherein the process comprises:

10 A. treating recycled waste water with a coagulant and with non-dissolved air which are injected into the recycled waste water;

 B. treating the recycled waste water with a material to adjust the pH of the recycled waste water;

 C. mixing the treated recycled waste water with untreated raw waste
15 water;

 D. adding a flocculating agent to the mixture of treated and untreated waste water to flocculate contaminants in the waste water mixture, whereby the air is entrapped within the flocculated contaminants.

 E. moving the waste water mixture to a unit in which the flocculated
20 contaminants rise to an upper area of the unit;

 F. removing the flocculated contaminants from the upper area of the unit;

 G. removing a first portion of the waste water mixture from a lower portion of the unit;

25 H. recycling a second portion of the waste water mixture through the process; and

5 I. adding a coagulant to the second portion of the waste water mixture
after the second portion is treated with a material to adjust the pH of the recycled waste
water.

18. A process as defined by Claim 17 wherein the coagulant is a tannin, lignin,
10 hydroxide, metal-containing compound, acidic compound or a mixture of such
compounds.

19. A process as defined by Claim 18 wherein the coagulant is ferric chloride,
ferric sulfate, aluminum chloride, aluminum sulfate or a mixture of such materials.

15 20. A process as defined by Claim 18 wherein the coagulant is sulfuric acid,
hydrochloric acid, nitric acid or a mixture of such materials.

21. A process as defined by Claim 18 wherein the coagulant is sodium
20 hydroxide, potassium hydroxide, calcium hydroxide or a mixture of such materials.

22 A process as defined by Claim 17 wherein the second portion of the waste
water mixture is recycled by a low pressure pump.

25 23. A process as defined by Claim 17 wherein the second portion of the waste
water mixture is recycled by gravity flow.

5 24. A process as defined by Claim 17 wherein the second portion of the waste
water mixture is recycled by a low pressure pump.

 25. A process as defined by Claim 17 wherein the second portion of the waste
water mixture is recycled by gravity flow.

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 26. A process as defined by Claim 17 wherein molecules of the non-dissolved
air attach to the coagulant, and an initial pin floc is formed in which the air molecules are
entrapped within the pin floc.

15 27. A process as defined by Claim 17 wherein the air is not pressurized to a
point at which air can be dissolved.

 28. A process as defined by Claim 17 wherein the waste water is recycled by a
pump which does not operate at the pressure required to dissolve the air.

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